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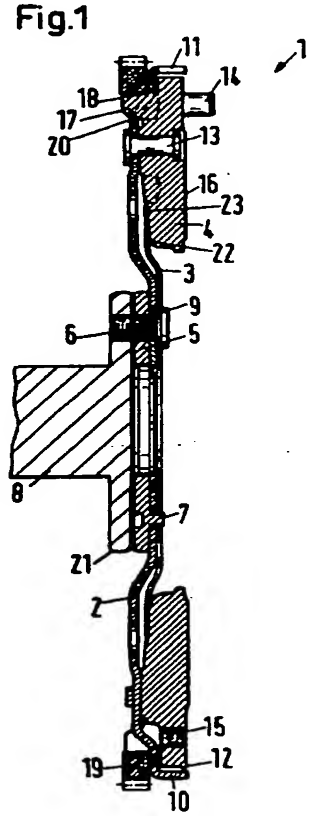
(54) Abstract Title
Axially flexible flywheel

(57) The flywheel comprises first axially flexible disc 2 mountable on crankshaft 8 and carrying clutch counter pressure plate 4 in a radially outer region thereof. To improve the axial damping effect, degressive second disc 3 is rivetted 7 to the first disc and extends therefrom to bear on the counter pressure plate, generating friction thereagainst. Starter gear 19 is mounted to the counter pressure plate on cams 17 protruding through windows in the first plate. Other arrangements include: an undulating ring (526 Fig. 7) between a reinforcing ring (505) and the counter pressure plate (504); an axially resilient spring ring (750 Figs. 9, 9a,b) between the first disc and counter pressure plate or slots (856 Figs. 10a-e) close to the retaining rivet (813); tongues (1103 Fig. 13) formed from the first disc engaging the counter pressure plate and; thermal insulation between counter pressure plate and first disc.

Fig.1



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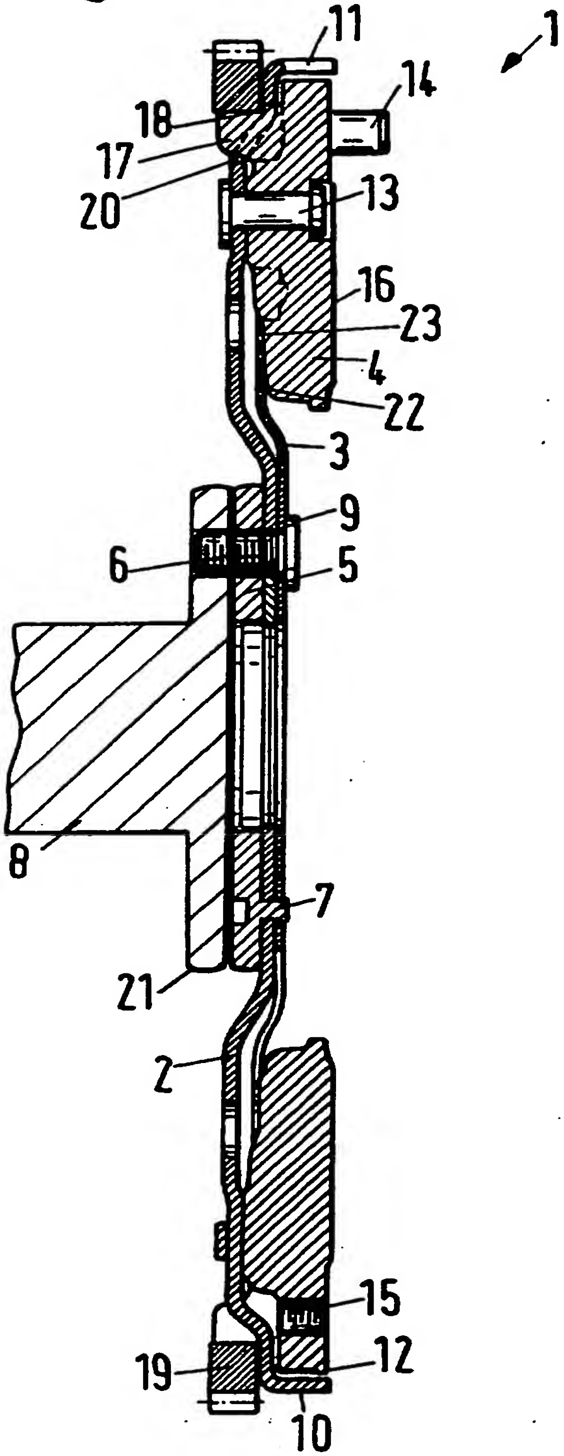
Fig.1
11
1
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Fig.2

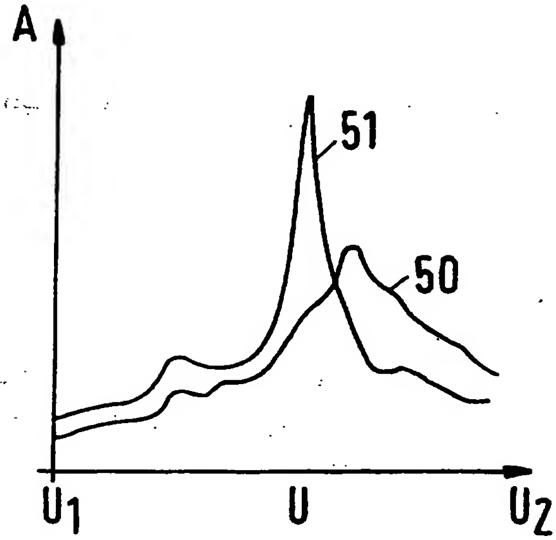


Fig.3

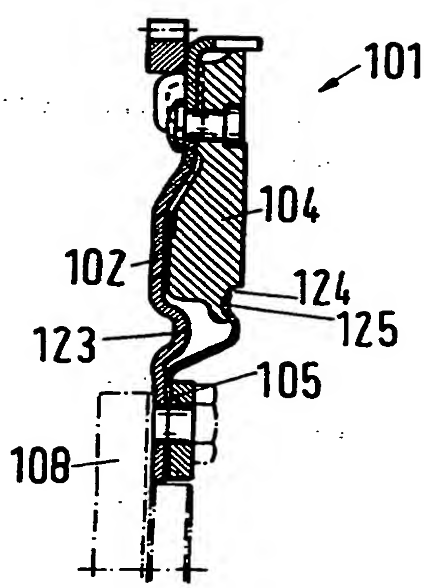


Fig.4

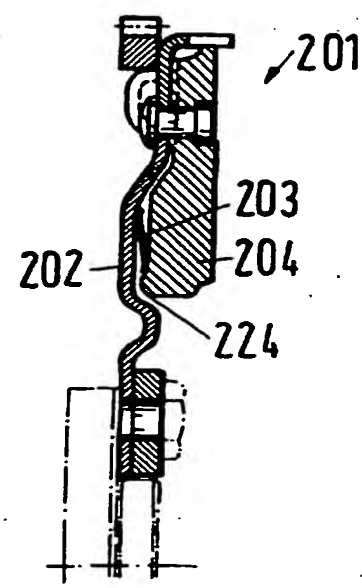


Fig.5

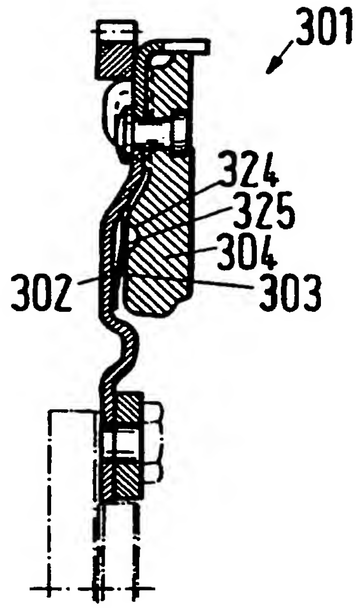


Fig.6

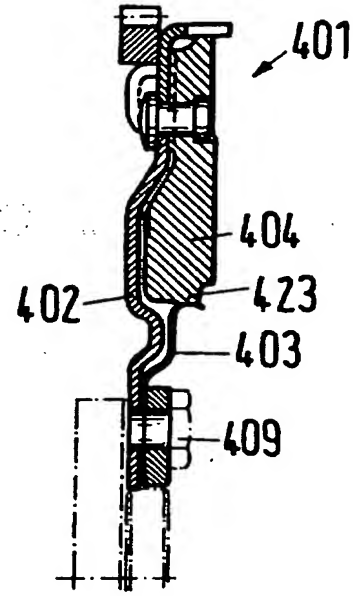


Fig.7

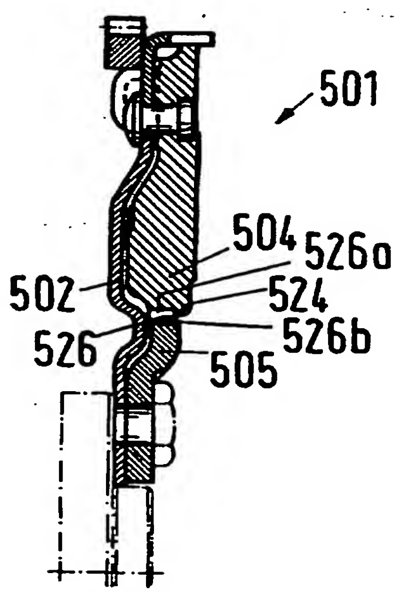


Fig.8

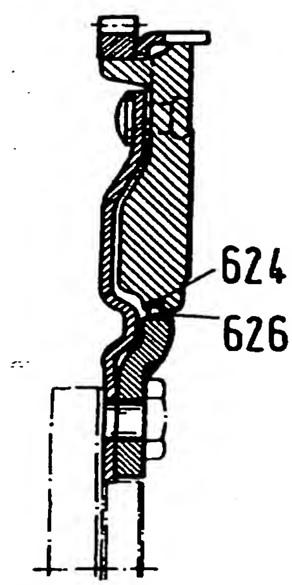


Fig.9

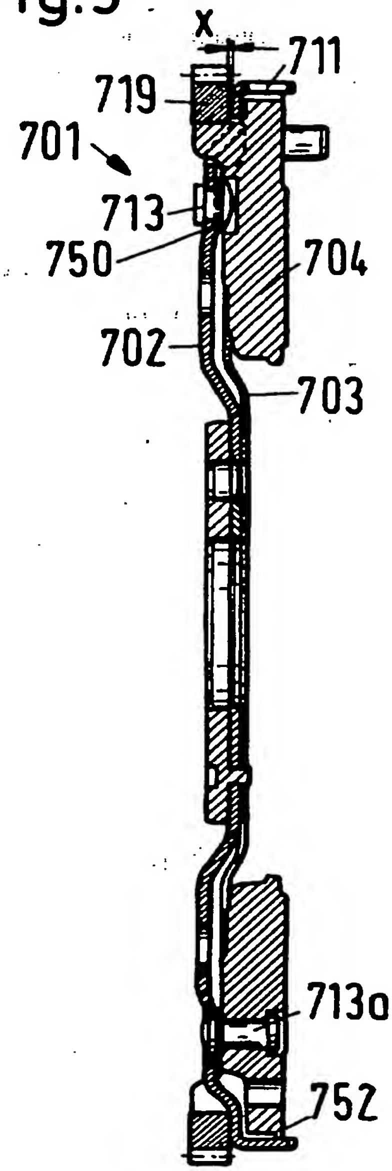


Fig.9a

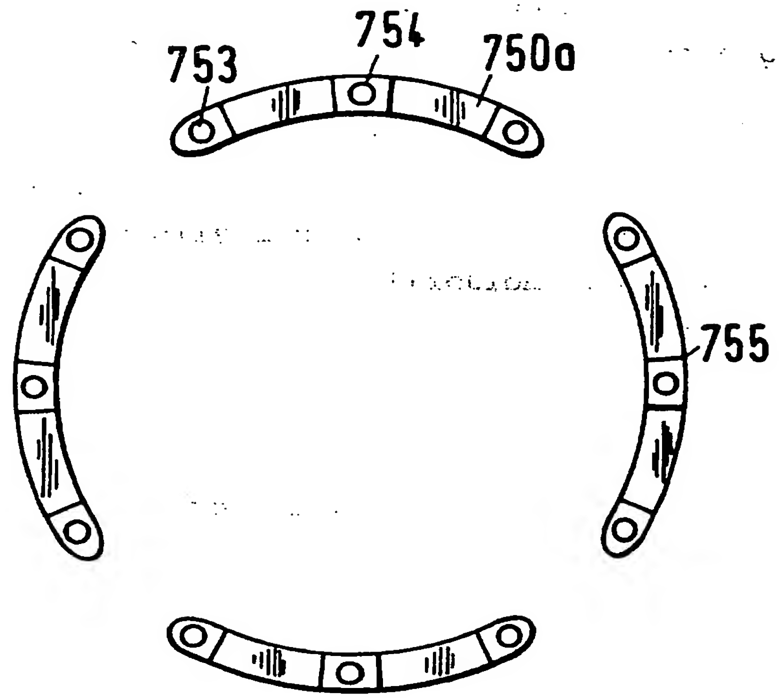


Fig.9b

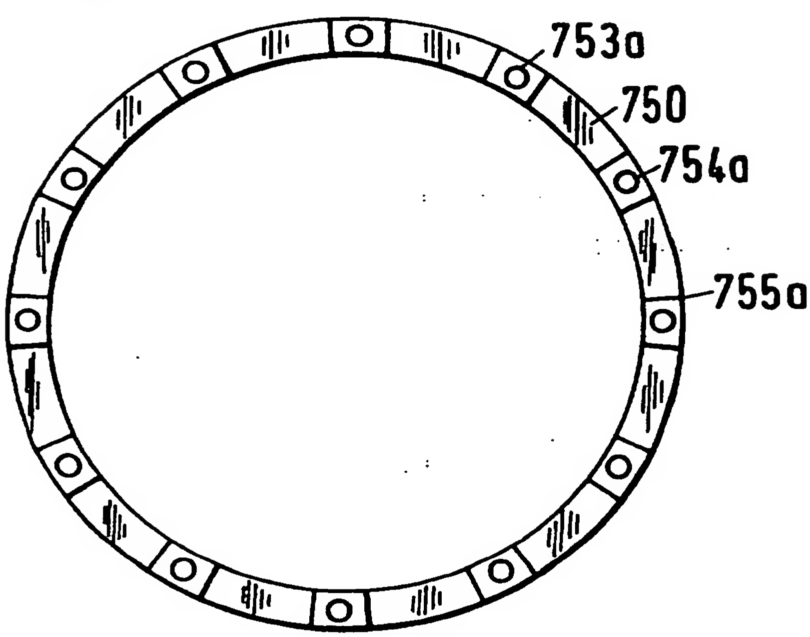


Fig.10

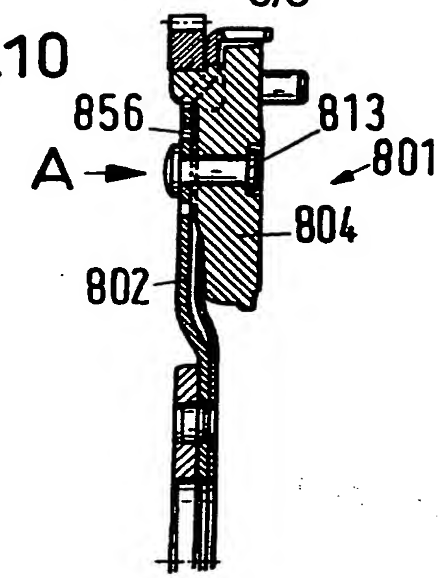


Fig.10a
(A)

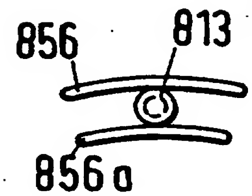


Fig.10b

Fig.10c

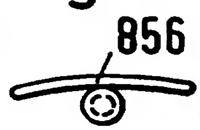
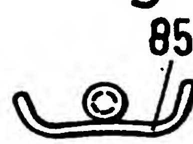


Fig.10d



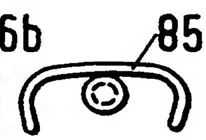


Fig.10e

Fig.11

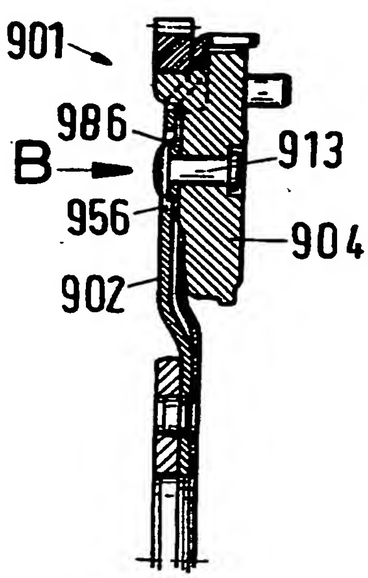


Fig.11a
(B)

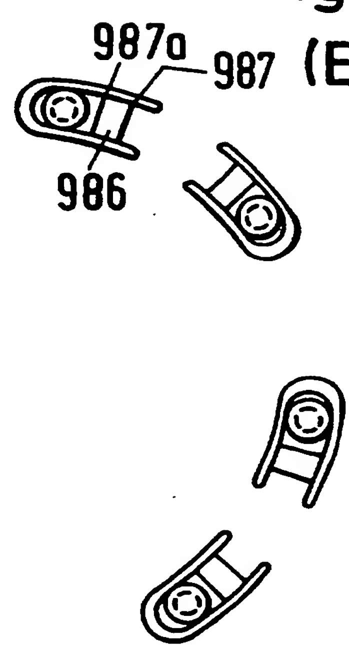


Fig.12

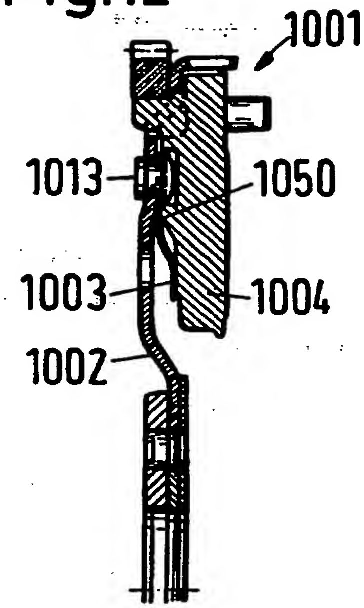
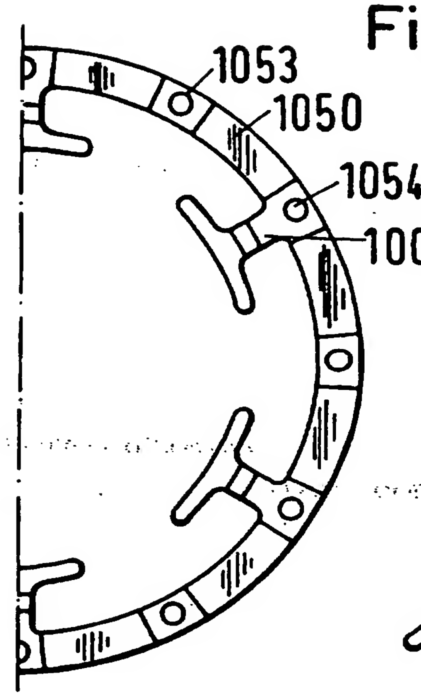


Fig.12a



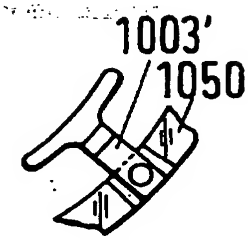


Fig.12b

Fig.13

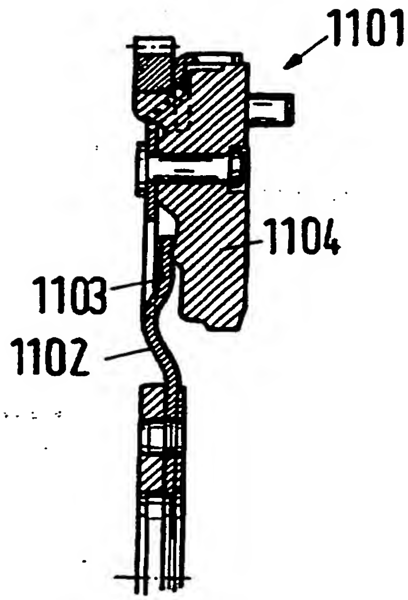


Fig.13a

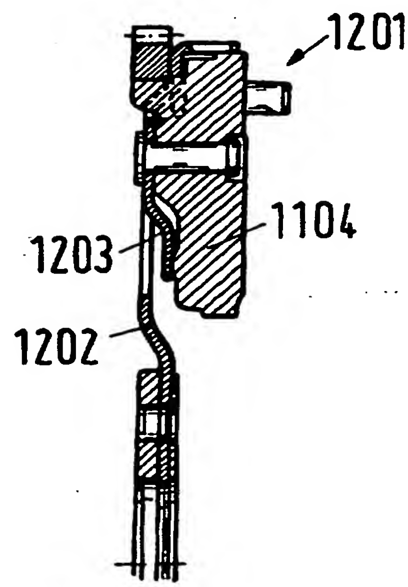


Fig.14

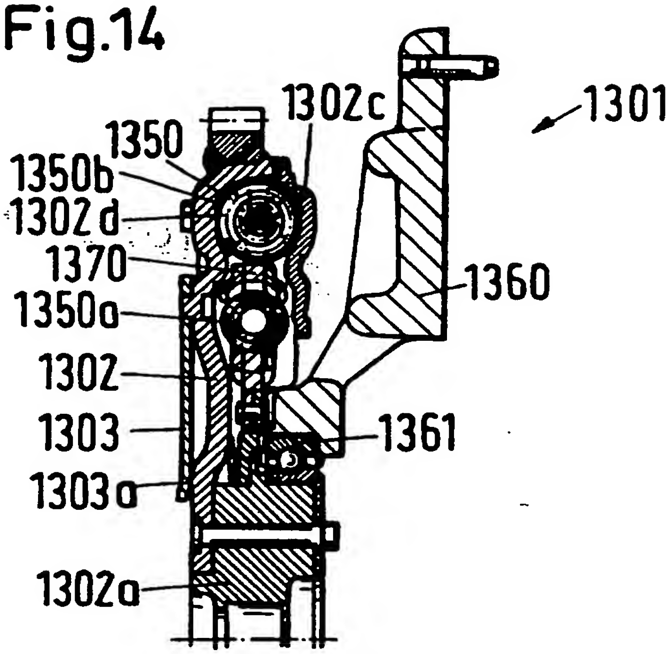


Fig.15

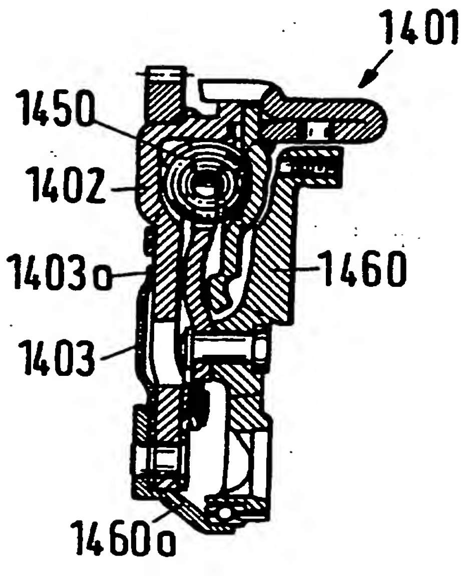


Fig.16

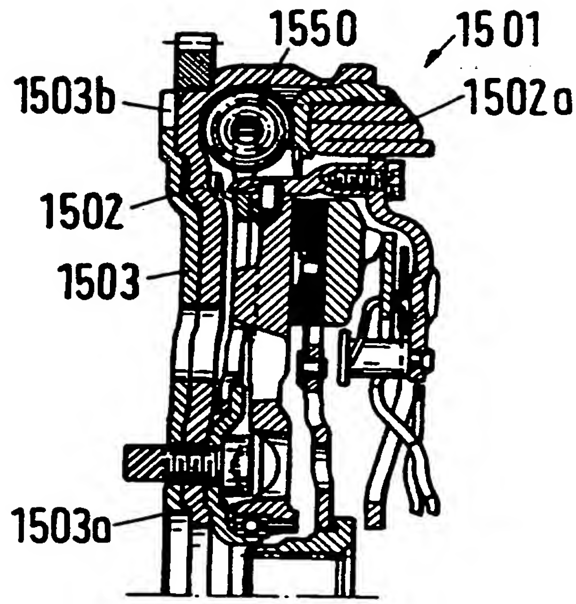


Fig.17

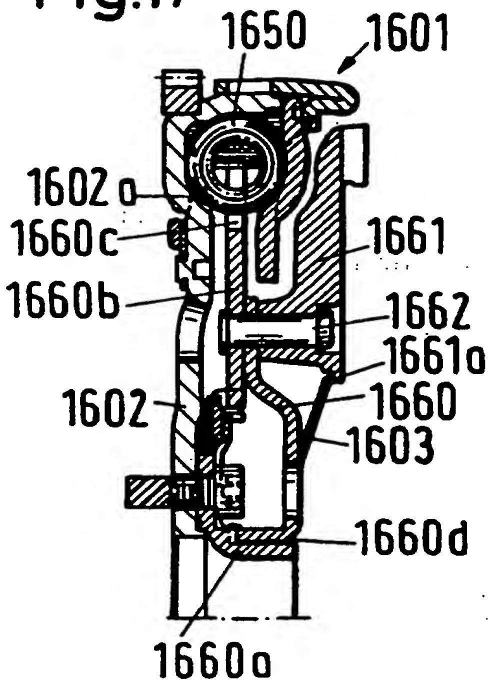


Fig.18

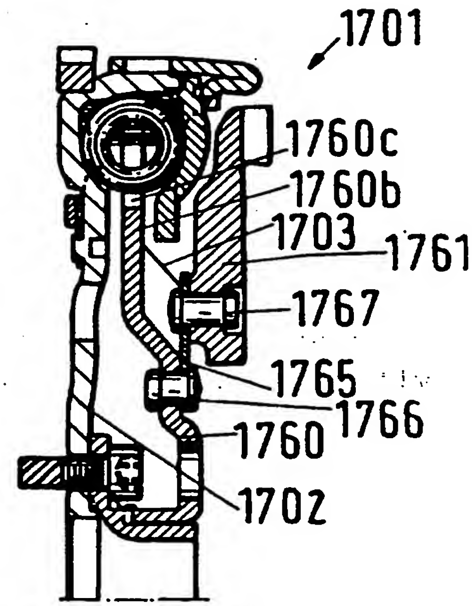


Fig.19

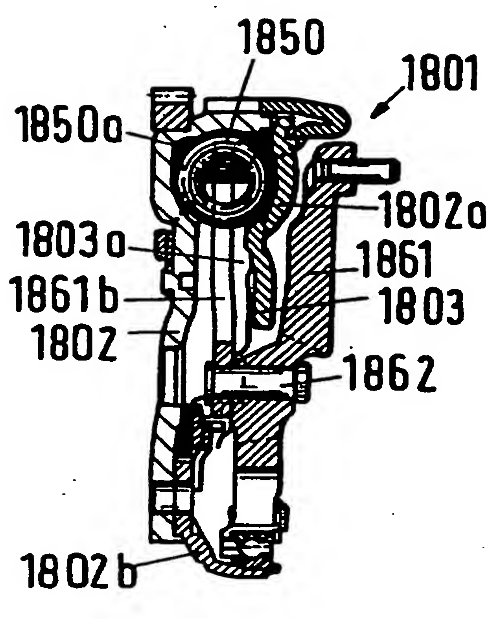
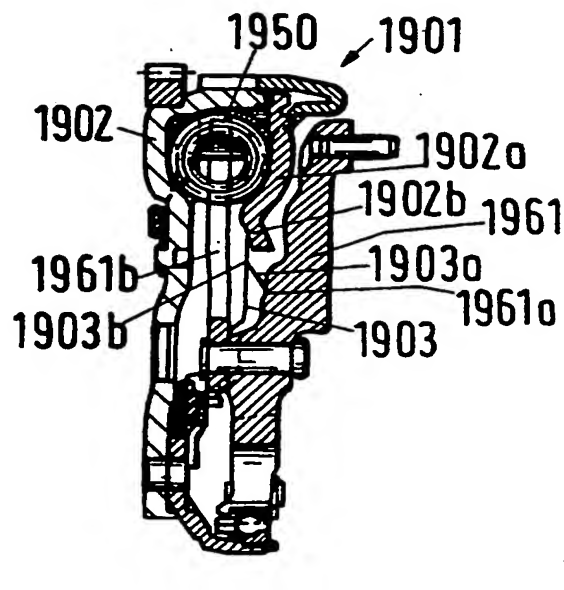


Fig.20



TORQUE TRANSFER DEVICE

The invention relates to a torque transfer device for the axial elastic connection of a crankshaft of an internal combustion engine to an output part of a drive train, more particularly a friction clutch or a fluid clutch such as a Fottinger clutch or hydrodynamic converter, at least comprising a disc part connectable to the crankshaft and on which an annular component part which forms the connection to the output part is connected on a radially outer region.

Torque transfer devices of this kind are known per se and are termed flexible flywheels since the design of the first disc part is made axially flexible and thus axial and/or bending vibrations of the crankshaft can be filtered out at least in part.

In order to restrict the maximum deflection of the axially flexible disc part, an arrangement is proposed in DE OS 44 02 257 which provides an intermediate part axially between the flexible disc part and the contact pressure plate so that after exceeding an axial play the intermediate part forms a stop for the contact pressure plate and thus defines the axial path of the disc part. After the play has been used up an arrangement of this kind is therefore likewise axially very stiff and, particularly in the higher speed ranges, transfers vibrations from the crankshaft to the clutch and further component parts of the motor vehicle with practically no reduction. The absence of an axial stop endangers the satisfactory operation of the clutch through the axial elasticity influencing the release process. An axially stiffer design of the disc part reduces the axial damping.

The object of the invention is therefore to provide an arrangement of a torque transfer device which shows over the entire useful speed range of the vehicle an improvement in the axial vibrations entering from the crankshaft. Furthermore the object of the invention is to design a corresponding torque transfer device which is simple and easy to assemble and to use component parts which can be used throughout the service life of the vehicle without any noticeable wear.

This is achieved through a torque transfer device which connects the crankshaft of an internal combustion engine axially elastically to an output part of a drive train, more particularly a friction clutch or a fluid clutch, such as a Fottinger clutch or hydrodynamic converter, and comprises at least one first disc part, which can be axially flexible, connectable to the crankshaft, and an annular component part secured fixed or axially flexible on a radially outer region of the first disc part and which forms the connection to the output part, wherein the first disc part is tensioned with the annular component part by means of a second axially elastic disc part or by tongues formed out of the first component part, or between the annular component part and the second disc part an axially operating friction engagement is produced by means of a radially elastic preferably metal component part.

It can be advantageous for an arrangement of this kind if between the first disc part and the annular component part a damping device is formed which through a resilient and a friction part suppresses axial vibrations and/or bending vibrations of the first disc part. It can therefore be advantageous to provide the contact surface of the tensioned parts - namely of the annular component part and the second disc part - for a micro friction so that

through the axial deflection of the first disc part an axially resilient action of the elastic second disc part can take place and at the same time a friction component in the micro range between the annular component part and second disc part produces a damping of the axial vibrations introduced from the internal combustion engine through the crankshaft to the first disc part.

To this end the second disc part can advantageously be tensioned by means of an axial end face with an end side of the annular component part facing the first flywheel disc part. The second disc part can likewise be tensioned in further embodiments by means of an axial end face with an end side of the annular component remote from the first flywheel disc part.

The second disc part can be fixed on the first disc part or on the annular component part, wherein fixing together with the first disc part on the crankshaft is particularly advantageous, wherein an additional reinforcement part can be mounted either axially between the crankshaft and first disc part or the first disc part can be mounted axially between the crankshaft and reinforcement part and/or the second disc part can be mounted between the screw heads for fixing the first disc part and the axially following component part wherein the second disc part can serve at the same time also as the reinforcement ring.

Furthermore according to the inventive idea the second disc part can be provided radially outside of the crankshaft screw connection with the first disc part whereby it can be particularly advantageous to mount the second disc part together with the annular component part on the first disc part. To this end the second disc part can have for axially supporting and/or producing a

friction engagement on the annular component part radially inwardly expanded tongues which expand circumferentially on their inner circumference, more particularly to increase the friction surface of the tongues.

It can be further advantageous to design the second disc part axially elastic, by way of example as a spring ring or of spring ring segments which spread out over the circumference can be combined by the fastening means for the annular component part and the first disc part into a closed spring ring. Through a circumferentially alternating fastening on the first disc part and on the ring shaped component part it is thereby possible independently or as an addition to the axially elastic properties of the first disc part to produce an axially elastic connection between the first disc part and the annular component part which with a suitable design can dampen additionally or alternatively to the first disc part and the elasticity of the first disc part can be formed substantially freely. It is evident that the spring ring can also be formed substantially and within the scope of its material properties and designs rigid as a fastening ring. The tongues can be attached in one piece with the spring ring or as discreet component parts with the fastening means wherein to match the axial pretension and/or friction engagement of the tongues with the annular component parts the tongues can be fixed with the fastening means which connect the spring ring to the first disc part and/or to the annular component part.

According to a further inventive idea first and second disc parts can be combined by forming at least one and preferably several circumferentially distributed tongues axially out of the first disc part which are placed axially against the annular component part and/or form a

friction engagement therewith wherein the tongues can be set up from radially outwards radially inwards and/or vice versa.

The axially elastic connection between the first disc part and ring-shaped component part by means of the spring ring can be restricted by an axial stop at least in one direction. To this end the starting gear ring can be provided radially on the outside. Furthermore with relative axial movement of the first disc part relative to the annular component part an additional friction engagement can be provided between an axial attachment on the outer circumference of the first disc part and the outer circumference of the annular component part.

According to a further inventive idea the spring ring can be integrated into the first disc part by providing separations - preferably with a part in the circumferential direction - of the disc material in the first disc part in the region of the fastening means which can be in particular rivet connections, whereby the axial elasticity can be increased in this region. By way of example separations can be formed radially inside and/or radially outside of the fastening means or tongues can be free cut and/or formed in the circumferential direction and/or radially outwards and/or inwards and in which the fastening means are housed for connecting the annular component. The circumferentially formed tongues can thereby be aligned in the drive and/or coast direction.

Arrangements of this kind can be advantageous not only for setting up the axial elasticity of the torque transfer device but in particular also serve for the thermal insulation of the annular component part from the first disc part. Particularly when using the torque transfer

device in connection with a friction clutch where the annular component part can serve as a contact pressure or pressure plate, very high temperatures can exist at the annular component which can have a negative effect on the material properties, for example the elastic properties, of the first component part at least over the service life of the torque transfer device.

Furthermore the second disc part as the component part fixing the friction engagement and/or at the same time axially tensioning the first disc part and the annular component part can depending on whether fixed on the first disc part or on the annular component part be in friction engagement with the annular component part or with the first disc part.

It can be further advantageous if the second disc part has a lesser axial stiffness than the first disc part.

According to the inventive idea the second disc part can furthermore have radially outwardly aligned tongues which are spread out over the circumference and are axially tensioned with the annular component part wherein the plate spring tongues can likewise fix a friction engagement with the annular component part.

Furthermore it can be advantageous to provide a torque transfer device for connecting a crankshaft of an internal combustion engine to an output part of a drive train, at least consisting of an axially flexible first disc part connectable to the crankshaft and on which an annular component part which forms the connection to the output part is mounted at a radially outer region, and wherein the second disc part is housed rotationally secured on the crankshaft and is in friction engagement with the annular

component part and the element forming the friction engagement is an annular component part which has elastic properties in the radial direction and is in friction engagement with the annular component part or with the second disc part at the circumference.

This element can be formed as an undulating ring which has radially outwardly directed undulations and serves as a friction disc between the second disc part and the annular component part wherein the peaks of the undulations on the outer circumference are in friction engagement with the inner circumference of the annular component part and the outsides of the troughs on the inner circumference are in friction engagement with the outer circumference of the second disc part. The undulating ring cross-section can thereby be rectangular, circular or the like.

In a further development a radially resilient disc part can be provided which is set on the crankshaft and is in direct friction engagement on its outer circumference with the inner circumference of the annular component part.

The torque transfer device can be provided for a friction clutch wherein the annular component part can form a contact pressure plate for the clutch, and a torque which can be coupled and uncoupled from the internal combustion engine is transferred to a gear input shaft through friction linings and a contact pressure plate. Furthermore in other embodiments the annular component can be formed as a mass ring on which a hydrodynamic converter or a Fottinger clutch is mounted secured against rotation.

Advantageously a starting gear ring is mounted on the annular component part on the outer circumference, for example on at least three axially aligned cams spread over

the circumference. These cams can be formed axially in the direction of the crankshaft or in the opposite direction wherein an alignment of the cams in the direction of the crankshaft can be particularly advantageous for reasons of space. In order to save axial structural space it can be further advantageous to provide the first disc part with window-shaped recesses corresponding to the cams so that the cams can engage through same and can be displaced in the axial direction to the combustion engine for the purpose of holding the starting gear ring. Furthermore the first disc part can have on its outer circumference a circumferential shaped area in the axial direction which is preferably remote from the starting gear ring and on which ignition markings are formed. This produces a particularly space saving arrangement where the first disc part is mounted axially between the starting gear ring and a mass part of the ring shaped component part wherein from the mass part of the annular component part the cams are arranged axially in the direction of the crankshaft and the ignition markings are arranged round the outer circumference of the annular component part.

For further optimising the first disc part profiled areas can be provided in the circumferential direction or in the radial direction on same to have a positive effect on the axial stiffness of the disc part. By way of example a circumferential swage can be provided radially between the annular component part and the crankshaft wherein the swage is advantageously indented axially in the direction of the annular component part.

For easier assembly the first disc part can be centred on the annular component by means of the shaped area for the ignition markings whereby the annular component can be

fitted with corresponding radially aligned centring cams. The annular component part is then advantageously connected to the first disc part, preferably by rivets or press-fit. The rivets can thereby be provided circumferentially at the radial level in the region of the contact bearing face for the friction linings of a friction clutch.

The arrangement of a torque transfer device can likewise be advantageous where a first axially flexible disc part is a constituent part of a divided flywheel having a primary flywheel mass and a secondary flywheel mass relatively rotatable opposite same against a circumferentially acting energy accumulator, wherein the axially flexible disc part can be axially tensioned by means of a second disc part of lesser axial stiffness.

It can thereby be advantageous to design the primary and/or secondary flywheel mass axially flexible wherein the correspondingly axially flexible component part can be formed as a one-piece disc part or of stiff and elastic component parts in a compound construction so that the primary and/or secondary flywheel mass is at least partially insulated with regard to vibrations from the crankshaft, which is loaded with axial or bending vibrations, through at least one axially flexible component in the force flow between the crankshaft and clutch. Thus by way of example a vibration insulation of the flywheel disc part of the secondary side, by way of example the pressure plate of a friction clutch, can be reached by means of an axially flexible disc part which is mounted on the primary part relatively rotatable against the action of the damping device, for example in the form of circumferentially acting energy accumulators, whereby

the axially flexible disc part can also consist of circumferentially distributed disc segments.

According to the invention each axially flexible component part or disc part is associated with a second disc part which can likewise be constructed of circumferentially spaced disc segments and has a lesser stiffness than the first axially elastic disc part. The second disc part is thereby axially tensioned directly or indirectly with the corresponding axially flexible disc part and can thereby form for example ring-shaped contact bearing faces which in the event of axial relative movement of the two disc parts relative to each other build up a friction torque which compensates at least in part the bending or axial vibrations produced from the crankshaft. It is evident that insulating the vibrations for damping the axial or bending vibrations of the crankshaft can also be advantageous for the vibrations entering from the drive train.

Advantageous designs for tensioning the axially flexible disc part with the second less stiff disc part can propose that the disc part can be housed with the first disc part on the crankshaft and can form radially outwards an annular contact bearing surface or friction surface or in a further embodiment is fixedly connected in a radially outer area to the axially flexible disc part, for example by rivets, and can form on its radially inner area an annular contact bearing face or friction face for the axially flexible disc part.

Furthermore it can be advantageous in the case of a divided flywheel to tension the axially flexible disc part with a less stiff disc part, wherein the tensioning disc part is tensioned axially between the secondary side and

the primary side, which thus at the same time can represent a friction device for relative rotations in the circumferential direction and a friction device in the case of an axial relative movement of the primary and secondary side. The friction surface can hereby be provided on the axially flexible disc part or on the stiff part and the fixing of the second disc part can be provided on the non-friction component on the opposite side. It can also be advantageous to fix the ring rotationally secured on neither of the two contact bearing faces whereby a friction surface is formed on the secondary side and a friction surface is formed on the primary side.

The invention will now be explained in further detail with reference to Figures 1 to 8 in which :

Figure 1	is a sectional view through an embodiment of a torque transfer device according to the invention;
Figure 2	shows a diagram illustrating the axial amplitude of the first disc part in dependence on the speed of the internal combustion engine compared with the prior art;
Figures 3 to 13a	show further embodiments of torque transfer devices according to the invention in partial sectional view, where applicable with detailed explanations and
Figures 14 - 20	show embodiments of a torque transfer device in sectional view as a divided flywheel.

Figure 1 shows an embodiment of a torque transfer device 1 with the first disc part 2, the second disc part 3 and the annular component part 4.

The torque transfer device 1 is connected to the crankshaft 8 with the axial interposition of a reinforcement ring 5 on the crankshaft side and to the second disc part 3 on the other side of the first disc part 2 by means of screws 9 which engage through the openings 6 provided in the parts 2, 3, 5. For easier assembly the reinforcement ring 5, the first and the second disc parts 2,3 are riveted together so that one integral component part is formed wherein the rivets 7 are formed from the reinforcement ring 5 by axially pressing alternately in the circumferential direction to the openings 6 and are riveted to the second disc part 2.

In the further radial path of the first disc part 2 to the outside in order to optimise the axial space required this disc part is sharply angled directly radially outside of the reinforcement ring 5 axially in the direction of the crankshaft 8 at least about the axial extension of the reinforcement ring 5 and after reaching the desired axial stagger is aligned again parallel to the screw plane of the screws 9. In the region of the outer diameter the first disc part 2 has a circumferential shaped area 10 axially remote from the crankshaft 8 so that the first disc part 2 is roughly pot-shaped in which circumferential ignition markings are formed which are detected by a transmitter (not shown) and transferred to an evaluator unit.

The annular component part 4 is mounted radially inside the axial shaped area 10 and is centred on the first disc

part 2 by means of circumferentially spaced out centring cams 12. The axial and rotationally secured connection with the first disc part 2 is produced by means of circumferentially spaced rivets 13. The annular component part 13 is in the illustrated embodiment formed as a clutch pressure plate with sockets 14 and threaded bores 15 for holding the remaining clutch constituent parts as well as the friction face 16 which is brought into friction engagement with the clutch disc and has in its radially outer region circumferentially spread out countersunk rivets 13 for fixing the annular component part 4 with the first disc part.

At least two, preferably four or six circumferentially spaced out cams 17 are shaped out on the annular component part 4 radially outside of the rivet circle 13 and extend axially in the direction of the crankshaft, with each cam having radially on the outside a contact bearing surface 18 onto which a starting gear ring 19 is drawn. The starting gear ring 19 can be fixed by welding, caulking and/or shrink-fitting. Window-shaped recesses 20 corresponding to the cross-sectional profile of the cams 17 are provided in the disc part 2 in the contact area between the cams 17 and first disc part 2 whereby the cams 17 are passed through same so that the starting gear ring 19 is mounted at approximately the same axial height as the collar 21 belonging to the crankshaft 8, or at least at the same axial height as the end of the crankshaft so that the axial space required by the torque transfer device 1 is reduced and/or an improved behaviour of the annular component part 4 acting as the flywheel mass is obtained.

The second disc part 2 is riveted to the first disc part 2 and to the reinforcement ring 5 to form one structural

unit 1 which is mounted and screwed on the crankshaft 8. Radially outwards the second disc part 3 substantially follows the first disc part 2 and is tensioned in the region of its outer circumference on the end side remote from the crankshaft with the end side of the annular component part 4 facing the first disc part, that is the second disc part is formed axially resilient, preferably with a lesser stiffness than the first disc part 2.

Radially outside the screws 9 or rivets 7 the second disc part 3 has tongues or spring tongues 22 radiating radially outwards and spread out over the circumference tensioned with the annular component part 4 wherein radially outwardly aligned swages 23 are formed on the annular component part 4 on the contact bearing faces corresponding to the number and shape of the tongues 22, so that these swages can also form an additional guide for the tongues 22 in the circumferential direction and thus improve the friction engagement of the tongues 22 on the annular component part 4.

The function of the torque transfer device 1 is that bending vibrations of the crankshaft caused through the ignition processes of the individual cylinders of the internal combustion engine create an axial vibration of the first disc part 2 which compared with stiff flywheels absorbs these vibrations in part and does not transfer them to the clutch or converter to the same extent as the stiff flywheels. Indeed a decreasing axial stiffness improves the transfer behaviour of these vibrations, but the release process of the clutch is affected where the co-ordination is too soft.

In the illustrated embodiment of a torque transfer device 1 therefore the second disc part 3 as an axially less

stiff component part is assigned parallel to the first disc part 2 wherein the second disc part 2 fixedly clamped only on one side - here on the first disc part 2 - and axially tensioned on the other side produces friction engagement.

In the event of axial displacement of the first disc part 2 through a bending vibration of the crankshaft 8, for example with an amplitude up to two millimetres, preferably one millimetre, this is deflected in the radial area predetermined by the screws 9 as fixing point and the rivets 13 which counteract a torque arising through the stiffness of the clutch construction, so that the second disc part 3 is tensioned with the annular component part 4 axially degressive against its stiffness, that is with a lesser contact bearing force as the axial deflection increases, and corresponding to the axial displacement of the first disc part 2 and thus of the annular component part 4, friction is produced between the second disc part 3 and the annular component part in the radial direction.

The effect of the damping device thus formed will be explained in further detail with reference to the diagram shown in Figure 2. Vibrations arise with the amplitude A in the drive train in dependence on the speed U of the internal combustion engine. The embodiment of a torque transfer device 1 is tuned to eliminate these vibrations and shows the behaviour 50 illustrated in Figure 2 compared to a behaviour 51 of a flexible flywheel or axially flexible flywheel according to the prior art without the second disc part 3.

At an engine speed range U between $U_1 \approx 2000$/min and $U_2 \approx 6000$/min an excitation of the drive train only occurs compared with the prior art at higher speeds U, for

example at about 4000 U/min. The amplitude of the excitation maximum is furthermore reduced with the design 1 by half compared to the prior art. The vibration behaviour has except for high - seldom used - speeds, in the overall speed band lower vibration amplitudes than a design fitted without the second disc part 3.

Figures 3 to 8 show further embodiments of torque transfer devices according to the invention wherein only the upper half of the device turning about its axis of rotation is shown in sectional view and which agree with the embodiment 1 of Figure 1 except for the differences described below regarding the corresponding figures so that the explanations made relating to Figure 1 - where transferable - also apply to the embodiments described below.

Figure 3 shows an embodiment of a torque transfer device 101 wherein the first disc part 102 has a circumferential swage 123 for optimising the axial stiffness of the torque transfer device 101 wherein the swage 123 preferably has the indentation axially in the direction of the second disc part 103.

The second disc part 103 is set on the crankshaft 108 axially between the reinforcement ring 105 and the first disc part 102.

The annular component part 104 is provided as a clutch pressure plate for holding the clutch and has on the end side remote from the crankshaft 108 a shoulder 124 adjoined by the second disc part 103 with friction engagement under axial tension. The tensioning is thereby produced axially against the first disc part 102 with a progressive contact pressure force, that is the contact

pressure force and the friction engagement resulting therefrom increases as the deflection of the first disc part 102 increases. To fix a defined friction surface which is not worked into the shoulder 124, the second disc part 103 is guided axially in an arc round the shoulder 124 and is formed on the outer circumference leading axially away from the shoulder 124 so that the friction engagement is produced with the annular component part 104 through a circumferential contact bearing face 125.

Figure 4 shows a further possibility of providing a radially acting friction device in the torque transfer device 201. The second disc part 203 is axially tensioned axially between the annular component part 204 and the first disc part 202 without fixing the disc part 203 on the crankshaft. A shoulder 224 provided in the annular component part 204 and radially inwardly adjoining the part 203 serves to fix the second disc part 2 radially which can be formed as a diaphragm or plate spring with corresponding axial elasticity. The spring acts degressively with axial deflection of the first disc part and can produce a friction engagement on its outer and inner circumference wherein the second disc part 203 is deflected radially outwards through compression in the event of deflection of the first disc part 202 to thereby produce the friction engagement.

It is evident that the second disc part 202 can have on the outer and/or inner circumference circumferentially spaced out radially outwardly aligned tongues (not shown here) which engage in corresponding recesses or shaped areas of the disc part 202 and/or the annular component part 204 and thereby fix in the circumferential direction and/or in the radial direction at least on one of the parts 202, 204 whereby other means, such as for example

complementary profiles can also be used to fix the second disc part 203 on the first disc part 202 and/or on the annular component part.

Figure 5 shows an example of a torque transfer device 301 wherein the second disc part 303 is hooked secured against loss with the annular component part 304 by means of axially aligned projections 325 provided on the outer circumference and corresponding circumferentially spaced indentations 324. The friction engagement in the radial direction can still be produced on the two parts 302, 304.

Figure 6 shows an embodiment of a torque transfer device 401 wherein a disc part 403 which is radially elastic at least on the outer circumference is tensioned on the outer circumference with the inner circumference, which to this end has a corresponding contact bearing surface 423, of the annular component part 404. To optimise the friction surface the disc part is drawn radially inwards circumferentially on the outer circumference.

A damping action is produced by the first disc part 402 tilting on the screws 409 as turning point. The first disc part 402 is thereby supported radially on the second disc part 403 and causes an axial friction engagement between the annular component part 404 and the second disc part 403.

The torque transfer device 501 illustrated in Figure 7 follows the principle underlying the torque transfer device 401, with a modified structural solution. To this end the reinforcement ring 505 is designed as a second disc part radially outwards and axially so that a circumferential gap is formed between it and the annular component part 504. An undulating ring 526 having a

rectangular cross-section is inserted under radial tension in this gap and rubs with its outer undulations 526a on the inner circumference of the annular component part 504 and with its inner undulations 526b on the outer circumference of the reinforcement ring 505. Thus a damping device is formed which in the event of axial deflections of the first disc part 502 counteracts the deflection through the spring constant of the undulating ring 526 with a radial spring force over the annular component part and defines an axial friction engagement through the friction of the reinforcement ring 505 on the annular component part 504.

A shoulder 524 provided in the annular component part serves to prevent the undulating ring from escaping in the axial direction or the swage 523 of the first disc part serves in the other direction.

In Figure 8 the undulating ring 526 of Figure 7 having the rectangular cross-section is replaced by an undulating ring 626 having a circular cross-section. Axial fixing is by means of a circumferential groove 624 provided in the annular component part 604.

Figure 9 shows a longitudinal sectional view through an embodiment of a torque transfer device 701 which is identical with the torque transfer device 1 of Figure 1 except for the following differences.

The connection of the disc part 702 is in this embodiment not directly on the annular component part 704 which can be a pressure plate for a friction clutch, but is through a spring ring, or through circumferentially spaced out leaf springs on whose one end the annular component part 702 is fixed and on whose other end the annular component

part 704 is fixedly attached, for example by rivets. The axial stiffness of the spring ring or of the leaf springs 750 can thereby be tuned to the axial stiffness of the disc part 702 whereby an additional damping can be achieved of the axial and/or bending vibrations of the crankshaft (not shown in this figure) in the direction of the drive train. In special applications the disc part 702 can be designed comparatively rigid, for example stiffer than for compensating axial vibrations relating to a resonance frequency in the range from 200 - 250 Hz, that is stiffer than a range dependent on the clutch mass from 600 kg/mm to 2200 kg/mm, and the axial vibrations are to be dampened substantially by means of the axially elastic means 750 in the force flow between the disc part 702 and the annular component part 704.

Furthermore in order to form a damping system the second disc part 703 can be tensioned through friction engagement with the annular component part 704 by forming a friction device. An alternative or an additional friction device 751 can be provided between a component part of the disc part 702, such as for example the ignition marking ring 711, and a component part of the annular component 704, for example a shoulder 752 which is radially expanded on its outer circumference and can consist of circumferentially spread out ring segments or a continuous nose which forms friction torque in the event of relative movement of the two component parts 702, 704.

In the torque transfer devices according to the invention, such as here the embodiment 701, an axial stop can be provided between the two parts 702, 704, which can be mounted in the region of the outer circumference and is here formed by the starting gear ring 719 and the ignition marking ring 711 which are axially spaced from each other

by the distance x when in the state of equilibrium. The distance x can occupy a region of less than 1 mm, preferably a region of less than 0.3 mm.

The connecting means 750 through its low heat flow thermally insulates the disc part 702 adequately from the annular component part 704 which is subjected for example as a clutch pressure plate to great temperature fluctuations as a result of the friction engagement with the friction linings. Advantageously the connecting means is made from a material having a low heat conductivity, for example stainless steel. The combination of an axially flexible material with a material having poor heat conductivity is particularly advantageous.

Figure 9a shows a spring ring 750 forming the connection between the two parts 702,704 (Figure 9) and formed from several preferably four spring ring segments 750a. The spring ring segments are firmly connected, for example riveted or screwed, by means of openings 753, 754 over the circumference alternately with the disc part 702 and the annular component part 704. As opposed to the use of leaf springs which are likewise advantageous the spring ring segments 750 are axially matched, whereby the axial stiffness can lie in a higher region. A further embodiment proposes overlapping the spring ring segments 750 and the disc part 702 or the annular component part 704 by means of fastening means engaging in the openings 753 of two spring ring segments, and the relevant other component part by means of the centre opening 754.

Figure 9b shows a closed spring ring 750b for the in particular axial flexible connection of the parts 702, 704 of Figure 9, wherein the openings 753a, 754a receive

fastening means 713, 713a alternating over the circumference of Figure 9 for fastening the disc part 702 to the annular component part 704.

In general the connecting part 750 of Figure 9 can have a single or multi stage spring rate - seen in the axial direction-, for which purpose the spring ring segments 750a and the spring ring 750b can have for example in the circumferential direction between the openings 753, 754 or 753a, 754a an axial profiled section 755 or 755a which divides the spring area between two openings 753, 754 or 753a, 754a into at least two different bending beams.

The torque transfer device 701 of Figure 9 can be built up with the elastic means 702, 750 previously described, and the friction devices into a damping system for damping axial vibrations which can be specially adapted to any type of internal combustion engine, drive train, drive and vehicle. To this end it is possible to combine together in particular the damping devices individually or jointly, single or multi stage, and several, for example two, friction devices producing different friction torques. More particularly it can also be advantageous to combine together friction devices which supply axial and radial friction parts. It can also be advantageous to provide preferred damping devices for the bending vibrations and axial vibrations, wherein the bending vibrations can be damped by damping devices preferably mounted in the radially outer region. Thus it can be advantageous for example to dampen one type of vibration - bending vibration or axial vibration - preferably with the connecting means 750 of Figure 9 whilst the other type of vibration can be mainly damped by means of the elastic disc part 702 (Figure 9). The number of possible resonance maxima can be increased by introducing one or more damping

elements (for example the spring ring 750) with different spring constants (where applicable in conjunction with at least one friction device, where greater friction work can be produced by using radially outer friction devices, as a result of the increased axial friction path - such friction devices being therefore especially advantageous). In this way a torque transfer device adapted to a drive train can dampen for example a typical resonance maximum for an axial vibration between 200 and 300 Hz and a resonance maximum for a bending vibration in the range from 600 to 800 Hz, and a better adaptation to the corresponding drive train can thus take place. It is thereby possible both to provide damping devices according to the low pass filter principle known per se for axial and bending vibrations and also to dampen the individual resonance frequencies individually.

Figure 10 shows a partial sectional view of an embodiment of a torque transfer device 801 wherein the disc part 802 is connected directly to the annular component part 804 by means of the fastening means 813, such as rivets. In the immediate vicinity of the fastening means 813 the disc part is provided with a separation 856 which on the illustrated example is provided in a circular segment shape radially outside in connection with a further separation 856a radially inside the fastening means. The view A of Figure 10 shown in Figure 10A explains the cut of the separations 856, 856a for a fastening means 813 which are distributed uniformly over the entire circumference.

Figures 10b - 10e show further advantageous design possibilities wherein in Figure 10b only a radially inner separation 856a is provided, in Figure 10c only a radially outer separation 856 and in Figures 10d and 10e

separations 856b, 856c are provided each radially engaging round the fastening means 813, namely from radially outside 856c in Figure 10e and from radially inside 856b in Figure 10d.

The advantages of the torque transfer device 801 having the variable designs of separations 856, 856, 856b, 856c lie in the thermal insulation of the two parts 802, 804 from each other and in an axial flexibility wherein the separations can advantageously be designed axially, for example by means of cold re-shaping technology. The torque transfer device 801 is to be manufactured cost-effectively by sparing the connecting means such as 750 in Figure 9.

With a design of the torque transfer device 901 - shown in Figure 11 - similar to the torque transfer device 801, the separations 956 are guided through the formation of circumferentially cut tongues 986, which can be axially arranged and/or aligned in the drive and/or coast direction of the torque transfer device 901. The fastening means 913 are located in the tongues for connecting the disc part 902 with the annular component part.

A partial view B of Figure 11 is shown in Figure 11a. Here tongues 986 are shown set up axially approximately parallel by means of two folded edges 987, 987a and arranged alternately in the drive and coasting direction of the torque transfer device 901. It is evident that all the tongues 986 can be aligned in the drive or coasting direction. The advantages of the torque transfer device 901 correspond substantially to those of the torque transfer device 801.

A further advantageous development of a torque transfer device 1001 is shown in Figure 12 whose second disc part forming a friction engagement with the annular component part 1004 (cf. the disc part 3 of Figure 1) is connected integral with the connecting means 1050. To this end the connecting means, in this case the spring ring 1050, has radially inwardly expanded projections 1003 which are adapted axially to the stagger relative to the annular component part 1004 and are tensioned axially with the annular component part 1004 to form friction engagement therewith.

Figure 12a shows a partial view of the spring ring 1050 with openings 1054 for receiving the fastening means 1013 for fixing the disc part 1002 and openings 1053 for receiving the fastening means for fixing the annular component part 1004. It is evident that the projections 1003 can also be arranged on the fastening means for fixing the annular component part.

The radially inwardly directed projections are expanded in the circumferential direction to increase for example the contact bearing face on the annular component part 1004.

Figure 12a shows a further design possibility of the projections 1003' on the spring ring 1050'. Here the circumferentially spread out projections 1003' are structurally separated from the spring ring 1050' and are fixed together with the fastening means for the disc part 1002 or the annular component part 1004 (Figure 12). This version is particularly advantageous when the material properties of the projections 1003 have to be different from those of the spring ring 1050', for example because the spring ring 1050' ought to have in addition thermally insulating properties.

Figures 13, 13a show further advantageous variations of a torque transfer device 1101, 1201, which are produced without a second disc part (cf. 3, Figure 1). The friction engagement with the annular component part 1104 is in this embodiment formed by circumferentially spread out tongues 1103 or 1203 formed out of the disc part 1102 or 1202. The tongues 1103 of the torque transfer device 1101 (Figure 13) are thereby aligned radially outwards and the tongues 1203 of the torque transfer device 1201 (Figure 13a) are aligned radially inwards. The tongues 1203, 1103 can be axially set up so that they can adjoin the annular component part 1104 through axial tension which can be variable in size.

Figures 14 to 20 show advantageous embodiments of axially flexible disc parts in a divided flywheel wherein each axially flexible disc part is tensioned axially with a second disc part of lesser stiffness. Thus with axial relative movement of the parts relative to each other a friction contact is formed in the contact bearing area of the two disc parts which can lead to a damping of the axial vibrations. Equally a relative rotation of the two parts relative to each other can also be provided so that in addition a friction device is provided in the circumferential direction wherein here the axially flexible disc part is associated with the primary side or the secondary side and the second less stiff disc part is tensioned axially between component parts of the primary side on the one hand and of the secondary side on the other.

Figures 14 to 16 show embodiments which have an axially flexible disc part in the primary area and Figures 17 to

20 show axially flexible disc parts mounted on the secondary side.

Figure 14 shows a partial sectional view of a torque transfer device as a divided flywheel 1301. The axially flexible primary disc part 1302 is mounted and riveted on a hub 1302a wherein the hub is fixed for example by means of screws on the crankshaft (not shown). The primary disc part forms radially outside with a flange part 1302c a chamber 1350b having inwardly extending biasing devices 1302 for the circumferentially acting energy accumulators 1350. Radially inside the energy accumulators 1350 a disc part 1302 is attached, for example as shown here by rivets, to the primary disc part 1302, and is axially tensioned on its inner circumference with the disc part 1302. In the event of relative movements of the two parts relative to each other a friction contact is hereby formed in the area 1303a between the disc part 1302 and the disc part 1303 with lesser stiffness so that in the event of axial vibrations of the disc part 1302 the latter can be damped.

The secondary disc part 1360 is mounted on the hub 1302a by means of a bearing 1361 and is relatively rotatable opposite the disc part 1302 relatively against the action of the energy accumulator 1350 or the energy accumulator 1350a belonging to a second damper stage. For biasing the energy accumulator 1350 or 1350a on the secondary side a flange part 1370 having corresponding recesses is connected rotationally secured, for example by rivets, to the secondary disc part 1360. The secondary disc part 1360 houses a friction clutch (not shown).

Figure 15 shows a construction of a divided flywheel 1401 similar to Figure 14 having an axially flexible primary

disc part 1402, a secondary disc part 1460 rotatable relatively opposite the disc part 1402 against the action of the energy accumulator 1450, as well as a disc part 1403 which has reduced stiffness compared to the stiffness of the disc part 1402 and which is mounted together with the primary disc part 1402 and a bearing dome 1460a for the secondary disc part 1460 on the crankshaft (not shown) and which is axially tensioned in the area 1403a with the disc part 1402 to produce a friction contact which in the event of axial vibrations of the primary side, more particularly of the disc part 1402, can have a damping action.

Figure 16 shows an embodiment of a divided flywheel 1501 which corresponds substantially to the embodiment 1401 of Figure 15 although there is the difference here that the second disc part 1503 is mounted with the primary disc part 1502 radially inside on the crankshaft (not shown) and is tensioned axially with the disc part 1502 radially level with the energy accumulator 1550, with the less stiff disc part 1503 being centred on the disc part 1502 by means of the centring nose 1503a. Furthermore the disc part 1503 has in the region of its outer circumference markings 1503b for the engine management system which are evaluated by a suitably arranged and designed sensor (not shown in further detail). The disc part 1502 is axially reformed on its outer circumference and provided with an additional primary mass 1502a. The divided flywheels 1403 and 1303 of Figures 14 and 15 likewise have these primary masses in a more or less reduced circumference, with the flywheel mass being formed on the disc part 1302 of Figure 14 substantially by the shape of the disc part and of the additional disc part 1302c as well as by the starting gear ring.

In the embodiment of a divided flywheel 1601 shown in Figure 17 the secondary side is designed axially flexible and the secondary flywheel mass is tensioned against the secondary disc part axially by means of a less stiff disc part.

The construction of the divided flywheel 1601 is thereby divided into a primary disc part 1602 which is set on the crankshaft, a secondary disc part 1660 which is set rotatable on a bearing flange 1660a fitted on the primary side, and a secondary flywheel mass part 1661 fixedly connected, for example by rivets, to the secondary disc part 1660.

The secondary disc part 1660 and the primary disc part 1602 are mounted rotatable relatively against the action of the energy accumulators 1650 wherein these are biased on the primary side by pockets 1602a and on the secondary side by a radially aligned flange 1660b with corresponding recesses 1660c. Radially between the bearing, for example here a slide bearing 1660d, and the circumferentially spaced rivets 1662 which connect together the flange 1660b, the flywheel disc 1661 and the secondary disc part 1660, the disc part 1660 is designed axially flexible so that axial vibrations or bending vibrations entering from the crankshaft through the disc part 1602 can be insulated in the secondary area and thus can be kept substantially away from the clutch, such as for example a friction clutch (not shown in further detail).

To this end, the disc part 1603 which has a reduced axial stiffness compared with the disc part 1660 is tensioned axially between the flywheel mass 1661 and the secondary disc part 1660, wherein in the illustrated embodiment the

disc part 1603 is supported on a radially protruding stop shoulder 1661a on the inner circumference of the flywheel mass part 1661 against the secondary disc part 1660 and where applicable in the event of relative movement of the two parts 1661, 1660 builds up a friction torque, preferably in the micro region. The disc part 1660 and/or the flywheel mass part 1661 can thereby serve as a friction partner.

Figure 18 shows a divided flywheel 1701 as described for the embodiment 1601 of Figure 17 except for the following differences which will be explained in further detail.

The design of the connection between the flange part 1760 and the flywheel mass part 1761 is different from the flywheel 1601 of Figure 1. Here these two parts 1760, 1761 are connected by means of an axially flexible disc part 1765 which can also be formed from a number of circumferentially spread out disc segments, for example radially on the inside by means of circumferentially spread out rivets 1766 on the secondary disc part 1760 and radially on the outside by means of circumferentially spread out rivets 1767 with the flywheel mass part 1761. The secondary disc part 1760 can thereby form the radial flange 1760b in one piece with the biasing devices 1760c and has increased stiffness relative to the axially more flexible disc part 1765 so that axial and/or bending vibrations entering from the crankshaft through the disc part 1702 are insulated substantially from the clutch on the disc part 1765.

Radially outside of the rivet circle 1767 the flywheel disc 1761 is tensioned axially with the flange 1760b, thus the secondary disc part 1760, whereby the means for axially tensioning is again a disc part 1703 which with

regard to its stiffness is weaker than the disc part 1765. As shown, the disc part is placed against the flange 1760b and is supported radially inwards on the disc part 1765 or the associated rivets 1767. A friction torque can be built up both between the flange part 1760b and/or the disc part 1765 on one side and the disc part 1703 on the other. It is evident that the disc part 1765 can also be connected radially inside the fastening on the secondary disc part 1760 to the flywheel mass part 1761.

Figure 19 shows an embodiment of a divided flywheel 1801 wherein the disc part 1802 is formed axially flexible and is supported axially against the secondary side. To this end the disc part 1803, for example a plate spring is tensioned axially between the secondary side and a flange part 1802 wherein the flange part 1802a is fixedly connected to the primary disc part 1802 for example by welding, and forms the chamber 1850a for holding the energy accumulators 1850. In the illustrated embodiment the disc part 1803 is fixed, for example by circumferentially spread out rivets 1862, axially between the flywheel mass part 1861 which is mounted rotatable relative to the disc part 1802 directly on the primary side on a bearing flange 1802b which in turn is connected to the crankshaft and the primary disc part 1802, and the flange part 1861b which represents the biasing device of the secondary side for the energy accumulators 1850. A friction contact is thereby produced in the region 1803a between the disc part 1803 and the flange part 1802a - here on the outer circumference of the disc part 1803. This friction contact produces a friction torque both in the case of an axial relative movement of the primary disc part 1802 through axial or bending vibrations and in the event of a relative rotation of the disc part 1802 relative to the flywheel mass part 1861, thus acts as a

friction device for axial or bending vibrations and for torsion vibrations, such as is known from friction devices of divided flywheels. With an increase in the stiffness in the axial direction it can be advantageous in order to reduce the basic friction during a relation rotation of the two component parts 1802, 1861 to mount the disc part 1801 rotatable relative to the secondary side, for example by means of a slide bearing. It can thereby also be advantageous to provide rotation with play so that from the friction device originally formed as a basic friction it is possible to provide a friction device with torsional play.

Figure 20 shows in principle the construction of a divided flywheel 1901 similar to the embodiment 1801 in Figure 19 wherein the spring force of the disc part 1903 between the flange part 1902a and the flywheel disc 1961 is counteracted by a compensation spring 1903a which is axially supported on the disc part 1903 and on a shoulder 1961a of the flywheel mass part 1961. The spring constants of the two plate springs 1903, 1903a are advantageously matched so that a small axial force acts on the contact bearing face 1902b and a large axial force acts on the contact bearing face 1903b of the two plate springs 1903, 1903a. From this, for a relative movement between the primary side and secondary side, thus the disc part 1902 with the flange part 1902b on one side and the flywheel mass part 1961 with the flange part 1961b on the other side, against the action of the energy accumulator 1950 a small friction torque arises at the friction area 1902b and in the event of axial vibrations of the disc part 1902 with the flange part 1902a against the flywheel mass part 1961 a large friction torque arises at the contact bearing face 1903b.

The patent claims filed with the application are proposed wordings without prejudice for obtaining wider patent protection. The applicant retains the right to claim further features disclosed up until now only in the description and/or drawings.

References used in the sub-claims refer to further designs of the subject of the main claim through the features of each relevant sub-claim; they are not to be regarded as dispensing with obtaining an independent subject protection for the features of the sub-claims referred to.

The subjects of these sub-claims however also form independent inventions which have a design independent of the subjects of the preceding claims.

The invention is also not restricted to the embodiments of the description. Rather numerous amendments and modifications are possible within the scope of the invention, particularly those variations, elements and combinations and/or materials which are inventive for example through combination or modification of individual features or elements or process steps contained in the drawings and described in connection with the general description and embodiments and claims and which through combinable features lead to a new subject or to new process steps or sequence of process steps insofar as these refer to manufacturing, test and work processes.

CLAIMS

1. Torque transfer device for connecting a crankshaft of an internal combustion engine to an output part of a drive train, more particularly a friction clutch or a fluid clutch such as a Fottinger clutch or hydrodynamic converter, the device at least comprising an axially flexible first disc part connectable to the crankshaft and on which an annular component part which forms the connection to the output part is connected on a radially outer region, characterised in that the first disc part is braced against the annular component by means of a second axially elastic disc part.

2. Torque transfer device for connecting a crankshaft of an internal combustion engine to an output part of a drive train, more particularly a friction clutch or a fluid clutch such as a Fottinger clutch or hydrodynamic converter, at least comprising a first disc part connectable to the crankshaft and on which an annular component part which forms the connection to the output part is connected on a radially outer region, characterised in that the annular component part is axially flexibly connected to the first disc part.

3. Torque transfer device for connecting a crankshaft of an internal combustion engine to an output part of a drive train, more particularly a friction clutch, at least consisting of a disc part and an annular component part forming a connection with the output part, characterised in that the disc part and the annular component part are thermally insulated from each other.

4. Torque transfer device more particularly according to one of the preceding claims characterised in that the

second disc part forms with the annular component a damping device for suppressing axial vibrations of the first disc part.

5. Torque transfer device, more particularly according to one of the preceding claims characterised in that the second disc part is housed with the first disc part on the crankshaft.

6. Torque transfer device more particularly according to one of the preceding claims, characterised in that the second disc part is tensioned by means of an axial end face with an end side of the annular component part facing the first disc part.

7. Torque transfer device, more particularly according to one of the preceding claims, characterised in that the second disc part is tensioned by means of an axial end face with an end side of the annular component part remote from the first disc part.

8. Torque transfer device, more particularly according to one of the preceding claims, characterised in that the second disc part is fixed on the first disc part or on the annular component part.

9. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is connected radially outside of the crankshaft to the first disc part and/or to the annular component part.

10. Torque transfer device, more particularly according to one of the preceding claims characterised in that the

second disc part forms a friction engagement with the annular component part or with the first disc part.

11. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part has a lesser axial stiffness than the first disc part.

12. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part has radially outwardly aligned tongues spread out circumferentially and axially tensioned with the annular component part.

13. Torque transfer device more particularly according to one of the preceding claims characterised in that the second component part is mounted on a connection between the first disc part and the annular component part.

14. Torque transfer device more particularly according to one of the preceding claims characterised in that the second component part is mounted axially between the first disc part and the annular component part.

15. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part has circumferentially distributed radially inwardly pointing tongues which form friction contact with the annular component part or with the first disc part.

16. Torque transfer device more particularly according to one of the preceding claims characterised in that the tongues are expanded radially inwards on one or both sides in the circumferential direction.

17. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is formed from an energy accumulator which develops an axial spring action.

18. Torque transfer device more particularly according to one of the preceding claims characterised in that the energy accumulator is a spring ring.

19. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is in at least two parts.

20. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part consists of a spring ring and tongues formed as separate parts.

21. Torque transfer device more particularly according to one of the preceding claims characterised in that the spring ring is formed at least from two spring ring segments.

22. Torque transfer device more particularly according to one of the preceding claims characterised in that the spring ring is connected over the circumference alternately to the disc part and to the annular component part.

23. Torque transfer device more particularly according to one of the preceding claims characterised in that a relative axial movement of the disc part and the annular component part is restricted.

25. Torque transfer device more particularly according to one of the preceding claims characterised in that an axial action of the axially active energy accumulator in relation to a relative axial movement of the disc part and the annular component part is single or multi-staged.

26. Torque transfer device more particularly according to one of the preceding claims characterised in that an axial action of the axially acting energy accumulator is asymmetrical in relation to a relative axial movement of the disc part and ring-shaped component part in the direction of the crankshaft or in the direction of the output part.

27. Torque transfer device for connecting a crankshaft of an internal combustion engine to an output part of a drive train, more particularly a friction clutch or a fluid clutch such as a Fottinger clutch or hydrodynamic converter, at least consisting of an axially flexible disc part connectable with the crankshaft and on which an annular component part which forms the connection to the output part is connected at a radially outer region, characterised in that at least one radially expanding tongue is formed out from the disc part and is supported on the component part.

28. Torque transfer device more particularly according to one of the preceding claims characterised in that the at least one tongue is axially supported.

29. Torque transfer device more particularly according to one of the preceding claims characterised in that the tongue forms friction engagement with the annular component part.

30. Torque transfer device more particularly according to one of the preceding claims characterised in that the connection of the first disc part with the annular component is produced by circumferentially distributed fastening means in whose immediate vicinity there is at least one separation of the first disc part provided with a circumferentially aligned part.

31. Torque transfer device more particularly according to one of the preceding claims characterised in that the separation is arranged radially inside and/or radially outside the fastening means.

32. Torque transfer device more particularly according to one of the preceding claims characterised in that the separation is made in the form of a tongue wherein the fastening means is provided on the tongue.

33. Torque transfer device more particularly according to one of the preceding claims characterised in that the tongue is aligned radially or circumferentially.

34. Torque transfer device more particularly according to one of the preceding claims characterised in that the circumferentially aligned circumferentially spaced out tongues are aligned uniformly in the coast or drive direction or mixed up in the drive and coast direction.

35. Torque transfer device for connecting a crankshaft of an internal combustion engine to an output part of a drive train, more particularly a friction clutch or a fluid clutch such as a Fottinger clutch or hydrodynamic converter, at least comprising an axially flexible first disc part connectable with the crankshaft and on which an annular component part which forms the connection with the

output part, is connected at a radially outer region, characterised in that the second disc part is housed rotationally secured on the crankshaft and is in friction engagement with the annular component part.

36. Torque transfer device, more particularly according to one of the preceding claims characterised in that the friction engagement between the second disc part and the annular component part is produced by means of an undulating ring with radially outward aligned undulations as friction disc wherein the undulations on the outer circumference are in friction engagement with the inner circumference of the annular component part and the undulations of the inner circumference are in friction engagement with the outer circumference of the second disc part.

37. Torque transfer device, more particularly according to one of the preceding claims characterised in that the undulating ring cross-section is rectangular or circular.

38. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is formed radially resilient and mounted on the crankshaft and is in friction engagement directly by its outer circumference with the inner circumference of the annular component part.

39. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is mounted axially on the crankshaft between the first disc part and a reinforcement ring.

40. Torque transfer device, more particularly according to one of the preceding claims, characterised in that the

annular component part is a contact pressure plate for a clutch.

41. Torque transfer device more particularly according to one of the preceding claims characterised in that a starting gear ring is housed on the outer circumference of the annular component part.

42. Torque transfer device more particularly according to one of the preceding claims characterised in that the starting gear ring forms an axial stop for the first disc part.

43. Torque transfer device more particularly according to one of the preceding claims characterised in that the starting gear ring is housed on at least three axially aligned cams spread out round the circumference.

44. Torque transfer device more particularly according to one of the preceding claims characterised in that the cams are aligned axially in the direction of the crankshaft.

45. Torque transfer device more particularly according to one of the preceding claims characterised in that the cams engage through corresponding window-shaped recesses of the first disc part.

46. Torque transfer device, more particularly according to one of the preceding claims characterised in that the first disc part has on the outer circumference a circumferential shaped area in the axial direction in which ignition markings are formed.

47. Torque transfer device, more particularly according to one of the preceding claims characterised in that the

first disc part runs radially outwards axially between the starting gear ring and a mass part of the annular component part.

48. Torque transfer device more particularly according to one of the preceding claims, characterised in that the first disc part has a circumferential swage radially between the annular component part and a locator on the crankshaft.

49. Torque transfer device more particularly according to one of the preceding claims characterised in that the swage is indented axially in the direction of the annular component part.

50. Torque transfer device, more particularly according to one of the preceding claims characterised in that the first disc part is centred on the annular component part by means of the shaped area.

51. Torque transfer device more particularly according to one of the preceding claims characterised in that the annular component part is riveted to the first disc part.

52. Torque transfer device, more particularly according to one of the preceding claims, characterised in that the riveting is produced circumferentially at the radial level in the region of the contact bearing surface for friction linings of a friction clutch.

53. Torque transfer device more particularly according to one of the preceding claims, characterised in that a first axially flexible disc part is a constituent part of a divided flywheel having a primary flywheel mass and a secondary flywheel mass which is relatively rotatable

opposite same against a circumferentially acting energy accumulator, and is axially tensioned by means of a second disc part of lesser axial stiffness.

54. Torque transfer device more particularly according to one of the preceding claims characterised in that the axially flexible disc part is associated with the primary or secondary flywheel mass.

55. Torque transfer device more particularly according to one of the preceding claims characterised in that the flexible disc part is mounted axially flexible on the crankshaft.

56. Torque transfer device more particularly according to one of the preceding claims characterised in that the axially flexible disc part forms a secondary disc part for holding a friction clutch wherein a primary disc part, mounted on the crankshaft, and the secondary disc part are mounted one on the other and are rotatable relative to each other in the circumferential direction against the action of at least one energy accumulator.

57. Torque transfer device more particularly according to one of the preceding claims characterised in that the axially flexible disc part connects together a pressure plate of the friction clutch and the secondary disc part.

58. Torque transfer device, more particularly according to one of the preceding claims characterised in that the second disc part is mounted on the crankshaft and is tensioned with the primary disc part preferably radially outwards and axially.

59. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is riveted round the circumference radially inwards or radially outwards with the primary disc part and is axially tensioned with the primary disc part radially in the opposite direction.

60. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is fixed on the secondary disc and is axially tensioned against the primary disc part or against the pressure plate.

61. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is fixed on the pressure plate or on the primary disc part and is tensioned axially against the secondary disc part or a component part connected thereto.

62. Torque transfer device more particularly according to one of the preceding claims characterised in that the component part connected to the secondary disc part is an axially acting energy accumulator.

63. Torque transfer device more particularly according to one of the preceding claims characterised in that the second disc part is rotatable relative to the axially flexible first disc part.

64. Torque transfer device more particularly according to one of the preceding claims characterised in that the axially flexible first disc part together with the second disc part form in their contact bearing area a friction device by means of relative rotation and/or an axial relative movement relative to each other.

65. Torque transfer device more particularly according to one of the preceding claims characterised in that the friction device is liable to play.

66. Torque transfer device substantially as herein described with reference to any one embodiment shown in the accompanying drawings.

67. Invention, formed from at least one of the features disclosed in the application documents.

Application No: GB 9929848.1
Claims searched: 1, 4-26, 28-34, 36-66
Examiner: J. C. Barnes-Paddock
Date of search: 9 March 2000.

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): F2U

Int Cl (Ed.7): F16D 3/06, 76, 77, 78, 79, 13/70; F16F 15/12, 129, 131

Other: Online: WPI, EPODOC PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0 789 153 A2	(EXEDY) See Figures 6 and 8 and col. 13, lines 26-34. Second plate member bracing against a counter pressure plate under bending conditions.	1,4-6,8,10 12,14,17 23,25,40 41,64,65 at least
X	US 5 515 745	(DAIKIN) See Figures 1 and 4 and Col 3, last paragraph. Flexible disc with radially outer connection to clutch pressure plate 5 and braced thereto by a spring disc 15.	1,4-6,8,10 12,13,14 17,23,25 40,41,64 65 at least
X P	DE 198 40 217	(DAIHATSU) See Figure and WPI abstract accession No - 1999-182282 [16]	1 at least
A	EP 0 717 211 A1	(EXEDY) See Figure. Two disc flexible flywheel.	
A	US 5 685 407	(FICHTEL & SACHS) See Figure 1. Radially inner portion of counter pressure plate bearing on ring 7.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.